Course Code	Course Title	ECTS Credits
MED-302	Microbiology and Virology	6
School	**Semester**	**Prerequisites**
Medical School	Fall (Semester 5)	None
Type of Course	**Field**	**Language of Instruction**
Required	Medicine	English
Level of Course	**Year of Study**	**Course Lead**
Undergraduate	3rd	Prof Peter Karayiannis
		Other lecturers:
		Dr Maria Koliou
		Dr Maria Alexandrou
		Dr Christos Karayiannis
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

This course aims to help students understand infectious diseases through the study of the general microbiology concepts of structure, growth and metabolism of microorganisms and viruses and their interrelationship with humans. The course also aims to train students in standard microbiology techniques utilized on a daily basis in laboratories. The main objectives of the course are to:

- Make students aware of the appropriate terminology in the fields of studying microorganisms and viruses.
- Differentiate between bacterial, viral, parasitic and fungal infections and to describe the mechanisms by which such microorganisms can cause disease.
- Become familiar with infectious diseases and the pathogens that cause them.
- Introduce the processes of infection of opportunistic and pathogenic microorganisms and the body's defence systems.
- Present the basic principles for the prevention and control of infections by microorganisms.
- Enable students to understand the mode of action of antibacterial, antiviral, antifungal and anti-parasitic drugs/compounds, and their use.
- Become familiar with the use of vaccines, their production and limitations.
- Enable students to make informed decisions on health and hygiene regarding infectious diseases.
- Provide the opportunity to practise in microbiology laboratory techniques and to draw and report appropriate conclusions from the analysis of experimental data.

Learning Outcomes:

The following list provides the learning objectives that will be covered in the lectures, and tutorials of each week:

Week 1

Lobs covered during lectures and tutorials:

1. Describe the purpose of microbe's existence on earth.
2. Outline the role of normal flora and describe the relationship between microbes and humans.
3. Describe bacterial characteristics, structure and classification
4. Describe the mechanisms of bacterial invasion of hosts and virulence factors.

5. Define various portals of entry and the routes of transmission of the infection.

Lob covered during lab practical:

6. Describe the main principles of the Microbiology laboratory practice, including biosafety rules, culturing techniques and media, Gram stain and microscopy in Microbiology.
7. Describe the principles of sterilization, disinfection and antisepsis used in routine laboratory practice.

Week 2

Lobs covered during lectures and tutorials:

8. Describe the metabolic processes of bacteria.
9. Outline the bacterial processes involved in replication and growth.
10. Describe the mechanisms of action and resistance of antimicrobials.
11. Describe the characteristics, virulence factors and clinical syndromes caused by *Staphylococci*.
12. Define the characteristics, virulence factors and clinical syndromes caused by *Streptococci* and *Enterococci.*

Lob covered during lab practical:

13. Outline the main steps and principles of specimen collection and transport and describe laboratory processing for the most important samples.

Week 3

Lobs covered during lectures and tutorials:

14. Define the definition of HCAI and nosocomial infections.
15. Outline the role of MDR bacteria in infections.
16. Describe the Standard precautions and Infection Control measures against HCAI.
17. Describe the characteristics, pathogenesis and clinical syndromes caused by *Haemophilus influenzae/ H. ducrei/ Gardnerella/ Bordetella/ Moraxella/ Legionella.*

Lob covered during lab practical:

18. Outline the main steps and technical procedures for the isolation and identification of the causative agents in staphylococcal and streptococcal infections.
19. Explain the main laboratory techniques used to differentiate between the species .

Week 4

Lobs covered during lectures and tutorials:

20. Describe the characteristics, pathogenesis and clinical syndromes caused by the *Neisseriae.*
21. Define the characteristics, virulence factors and clinical syndromes caused by *E. coli, Salmonella/Shigella* and other *Enterobacteriaceae.*
22. Define the characteristics, virulence factors and clinical syndromes caused by *Pseudomonas aeruginosa* and *Acinetobacter baumanii.*
23. Describe the characteristics, pathogenesis and clinical syndromes caused by *Bacillus anthracis* and *Bacillus cereus.*
24. Define characteristics and clinical relevance of *Actinomycetes* and *Spirochetes*.

25. Describe the characteristics, pathogenesis and clinical syndromes caused by *Vibrio*, *Aeromonas, Campylobacter, Helicobacter* and *Clostridium sp.*

Lob covered during lab practical:

26. Outline the main steps and technical procedures for the isolation and identification of *Enterobacteriaceae* and non-*Enterobacteriaceae* gram negatives.
27. Explain the main laboratory techniques used to differentiate the main species between them.

Week 5

Lobs covered during lectures and tutorials:

28. Describe the characteristics, pathogenesis and clinical syndromes caused by *Mycoplasmas* and *Chlamydiae*.
29. Describe the characteristics, pathogenesis and clinical syndromes caused by *Bacteroides/Fusobacterium* and other non-spore forming anaerobes.
30. Describe the characteristics, biology, virulence, pathogenicity, epidemiology of *Clostridium difficile* and outline the main principles of Infection Control.
31. Describe the main mechanisms of immune response against infections and the role of vaccination.
32. Discuss the characteristics, pathogenesis and clinical syndromes caused by *Mycobacterium tuberculosis* and antimicrobial treatment.
33. Describe the characteristics, pathogenesis and clinical syndromes caused by *M.leprae* and non-tuberculous mycobacteria.
34. Describe the major methods of susceptibility testing and recognise the resistance phenotypes most frequently found in a clinical microbiology laboratory.
35. Define MIC and MBC.

Week 6

Lobs covered during lectures and tutorials:

36. Describe the characteristics, pathogenesis and clinical syndromes caused by *Rickettsia, Bartonella, Francisella, Streptobacillus, Pasteurella, Borrelia, Yersinia, Coxiella, Ehrlichia* and *Anaplasma.*
37. Outline the main bacterial zoonoses.
38. Describe the characteristics, pathogenesis and clinical syndromes caused by *Brucella, Listeria and Leptospira.*
39. Describe the characteristics, pathogenesis and clinical syndromes caused by *Corynebacteria.*
40. Describe viral structure, virion components, nucleic acid replication and different types of viral life cycles.
41. Explain the concept of viral tropism (infectivity).
42. Describe portals of entry into the body and define pathogenicity.
43. Explain acute, chronic and latent viral infection.
44. Explain the criteria for the classification of viruses and introduction of DNA virus families.

Week 7

Lobs covered during lectures and tutorials:

45. Describe the symptoms and diseases caused by DNA viruses such as Herpes, Hepatitis B and Papilloma viruses.
46. Differentiate between the different hepatitis viruses and serological profiles.
47. Explain the criteria for the classification of RNA viruses and introduction of RNA virus families
48. Describe viral genetics and manipulation of their genomes for various purposes.

Midterm Exam.

Week 8

Lobs covered during lectures and tutorials:

49. Describe the symptoms and diseases caused by RNA viruses such as HIV, Rabies, flavi- and filoviruses.
50. Describe viral infection in childhood and recognise differences in rashes (exanthemata) produced.
51. Describe signs and symptoms of respiratory infections by myxo- and paramyxoviruses, rhino- and coronaviruses.
52. Explain seasonality of flu viruses and the concept of genetic drift or shift.

Week 9

Lobs covered during lectures and tutorials:

53. Describe the role of the immune system in the clearance or not of viral infections.
54. Describe different mechanisms of immune evasion by viruses.
55. Discuss different types of vaccines for both bacteria and viruses, and immunisation schedules.
56. Define mechanisms of action of antiviral drugs.
57. Discuss use of antivirals depending on virus infection.
58. Explain the reasons for antiviral drug resistance.

Week 10

Lobs covered during lectures and tutorials:

59. Define mycology and the importance of fungi in nature.
60. Describe the relationship of fungi to other organisms and their role in disease.
61. Describe fungal classification and taxonomic features.
62. Define fungal structure, antigenicity, pathogenicity and immune response.
63. Describe the morphological characteristics of yeasts, their reproduction and their medical importance.
64. Describe the morphological characteristics of moulds, their reproduction and their medical importance.
65. Define macroscopic and microscopic features of yeasts and moulds.
66. Perform differential diagnosis between yeasts and moulds and between the main species.
67. Perform antifungal susceptibility testing.

Week 11

Lobs covered during lectures and tutorials:

68. Define phylogenetic classification of fungi and recognise representative genera causing fungal infections.
69. Define dimorphic fungi and dermatophytes and their role in fungal infections.
70. Describe the most important superficial and systemic mycoses and their laboratory diagnosis.
71. Describe the mode of action of antifungals, route of administration and spectrum of activity.
72. Describe clinically significant mycotoxins and mycotoxicoses.
73. Describe the basic biology and life cycles of human parasites, human parasitic infections, including their epidemiology, clinical features, laboratory diagnosis, treatment and prevention.
74. Describe the ways by which parasites affect their hosts.

Week 12

Lobs covered during lectures and tutorials:

75. Examine the clinical and pathological manifestations of the most important and prevalent parasitic infections.
76. Describe the factors which determine the geographical distribution of parasites and influence the host-parasite relationship.
77. Critically analyse the results of laboratory investigations.
78. Be able to make a differential diagnosis of some of the most important and prevalent parasitic infections.
79. Examine methods of treatment of various parasitic infections.
80. Identify all the important parasites affecting humans.
81. Become familiar with parasitological terminology.
82. Train in the use of equipment and become familiar with laboratory methods for the diagnosis of parasitic diseases.
83. Recognize the basic morphologic criteria and differentiate between the most common parasites.

Course Contents:

Bacteriology:

- Introduction to Medical Microbiology
- Human Microbiome and the Relationship between host and microbes
- Microorganisms' classification, cell structure
- Mechanisms of Bacterial Pathogenesis and Routes of transmission.
- Metabolic processes
- Replication and growth
- Antibacterial agents: Classification, Activity Spectrum and Mechanisms of action
- *Staphylococci*
- *Streptococci/ Enterococci*
- HCAI (Health Care Associated Infections). MDR (Multi-Drug-Resistance) microorganisms and their role in infections.
- Infection control. Standard Precautions measures.
- Miscellaneous Gram Negative and pleomorphic bacteria: *Haemophilus, Gardnerella, Bordetella, Moraxella, Legionella.*
- *Enterobacteriaceae* –Part I: E. coli
- *Enterobacteriaceae* –Part II: *Klebsiella, Proteus, Enterobacter, Salmonella, Shigella*

and others. Non-fermenting Gram Negative Bacilli: *Pseudomonas , Acinetobacter.*

- *Neisseria meningitidis* and meningococcaemia
- *Neisseria gonorhoeae* and gonorrhoea
- Immune Response to Infections and vaccines
- Miscellaneous Gram positive & Gram negative and other fastidious and pleomorphic bacteria Part I: Aerobic Gram-Positive Bacilli & Branching Filamentous Bacilli. *Spirochetes.*
- Miscellaneous Gram positive & Gram negative and other fastidious and pleomorphic bacteria Part II: *Vibrio, Aeromonas, Camplylobacter, Helicobacter, Clostridium*.
- Other pleomorphic bacteria: *Mycoplasmas* and *Chlamydiae.*
- Non spore-forming anaerobes: *Bacteroides, Fusobacterium* and others
- *Clostridium difficile*: Characteristics, Biology, Virulence, Pathogenicity, Epidemiology and Infection Control.
- *Mycobacterium tuberculosis* and related Acid-Fast Bacteria.
- Tick-borne Diseases, Cat Scratch Diseases and Rat Bite Fever (*Ricketsia, Bartonella, Francisella, Streptobacillus, Pasteurella, Borrelia, Yersinia, Coxiella, Ehrlichia* and *Anaplasma).*
- Bacterial Zoonoses (*Brucella, Listeria, Leptospira*).
- *Corynebacteria*

Virology:

- Viral structure
- Tropism and pathogenicity
- Classification and DNA viruses
- DNA viruses: Herpes/ Hepatitis B / Papilloma
- Classification of RNA viruses
- RNA viruses: HIV/Rabies/Flaviviruses/ Filoviruses
- Childhood infections
- Respiratory infections
- Immune responses
- Vaccines
- Antivirals and resistance
- Viruses of medical importance (tutorial)

Mycology:

- Introduction to Mycology and Fungi
- Fungal classification, structure and pathogenicity
- Yeasts
- Moulds
- Fungal infection
- Dimorphic fungi and Dermatophytes
- Mycoses

Parasitology:

- Introduction to parasitology
- Protozoa
- Blood and tissue flagellates
- Sporozoa

- Platyhelminthes: Trematodes, Cestodes
- Platyhelminthes: Nematodes

Lab practicals and Demonstrations:

- Bacteriology: a. General Principles of Laboratory Diagnosis (Microscopy and *in vitro* cultures, types of culture media. Bacterial isolation and identification and microscopy and staining). b. Sterilization, Disinfection, and Antisepsis.
- Bacteriology: Specimen collection, transport and laboratory processing in laboratory practice.
- Bacteriology: Laboratory diagnosis of *Staphylococcal* and *Streptococcal* infections: Microscopy, Culture, Biochemical characteristics and Identification. MIC and AST of *Staphylococci* and *Streptococci.*
- Bacteriology: Laboratory diagnosis of *Enterobacteriaceae* and most common non-fermenting Gram Negative Bacilli: Microscopy, Culture and Identification, AST.
- Bacteriology: Conventional Laboratory techniques for AST (Antimicrobial Susceptibility Testing) in a routine Clinical Microbiology Laboratory. MIC & MBC explanation. Resistance phenotypes most frequently found in clinical practice.
- Mycology
- Parasitology

Learning Activities and Teaching Methods:

Lectures, Tutorials, Laboratory Practical Sessions.

Assessment Methods:

Midterm Exam (35%) and Final Exam (65%). Assessment is by Single Best Answer MCQs (SBAs) and Short Answer Questions (SAQs).

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
Patrick R. Murray & Ken S. Rosenthal & Michael A. Pfaller	Medical Microbiology (8^{th} Edition)	Elsevier	2015	9780323299565

Title	Publisher	Year	ISBN
Step 1 Lecture Notes 2016 in Immunology & Microbiology.	Kaplan	2016	9781506200477